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Der Präsident des Europäischen Patentamts;
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Wellbore device for selective transfer of fluid

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WELLBORE DEVICE FOR SELECTIVE TRANSFER OF FLUID

The present invention relates to a wellbore device comprising a fluid passage for transferring fluid between an earth formation and a surface facility.

5 In the production of hydrocarbon fluids from a wellbore formed in the earth formation it can be desired to prevent transfer of a selected fluid between the earth formation and the surface facility. For example, the hydrocarbon fluid reservoir generally overlays a water-containing layer of the earth formation. After
10 continued production of oil or gas from the reservoir, the water level below the reservoir may rise to the level of the intake zone of the wellbore. Also, under certain conditions of hydrocarbon fluid production an effect named "water-coning" may occur whereby water is drawn
15 from the water-containing layer to the wellbore intake zone. As a result an increased amount of water will be produced, at the cost of production of hydrocarbon fluid. Such undesired fluid production can significantly reduce the economics of a hydrocarbon fluid prospect. Thus,
20 there is a need to provide a means for reducing the transfer of undesired fluid while still allowing the transfer of desired fluid.

Accordingly, it is an object of the invention to provide an improved wellbore device comprising a fluid
25 passage for transferring fluid between an earth formation and a surface facility, which device meets the aforementioned need.

In accordance with the invention there is provided a wellbore device comprising a fluid passage for transferring fluid between an earth formation and a surface facility, and a body transferable from a first mode to a second mode upon contact of the body with a selected fluid, said body being arranged so as to substantially close the fluid passage upon transfer of the body from the first mode to the second mode due to contact of the body with the selected fluid.

It is thereby achieved that, when the selected fluid reaches said body, the fluid passage becomes closed so as to prevent transfer of the selected fluid between the formation and the surface facility. If the selected fluid is an undesired formation fluid such as formation water, transfer of the undesired fluid from the formation to the surface facility is thus prevented.

Suitably the wellbore device is adapted to be arranged in a wellbore formed in the earth formation.

Preferably said body has a larger volume in the second mode than in the first mode.

In a preferred embodiment of the device, said body comprises a body of swelleable material which swells upon contact of the body with the selected fluid, said body of swelleable material being arranged so as to substantially close each fluid passage upon swelling of said body due to contact of the body with the selected fluid.

Selective inflow of desired fluid into the wellbore while preventing inflow of undesired fluid is preferably achieved by providing said body with a plurality of said fluid passages, whereby only a part of said body is swollen due to contact of said part of the body with the selected fluid, and wherein the fluid passages formed in

the swollen part are closed while the fluid passages in the remaining part of said body are open.

Advantageously the device further includes a perforated tubular conduit, and wherein the body of swelleable material includes a sleeve of swelleable material, said sleeve extending around the perforated tubular conduit.

To prevent sand production from the wellbore, suitably the perforated tubular conduit is provided with a filter layer preventing flow of sand particles from the wellbore to the surface facility.

Suitably the filter layer is arranged between the perforated tubular conduit and the sleeve of swelleable material.

The sleeve can be, for example, a permeable sleeve, a perforated sleeve, or a sleeve having an open weave structure.

The invention will be described hereinafter in more detail and by way of example with reference to the accompanying drawing in which:

Figure 1 schematically shows an embodiment of the wellbore device of the invention.

Referring to Fig. 1 there is shown a lower part of a wellbore 1 formed into an earth formation 3 having a zone 4 containing hydrocarbon oil, and a zone 5 containing water below the hydrocarbon oil zone 4. A casing 6 extends from surface to a depth at a selected distance from the wellbore bottom 8. A cement layer 10 between the casing 6 and the wall 12 of the wellbore 1 fixes the casing 6 in the wellbore.

A radially expandable production liner 14 extends from within the lower end part 16 of the casing 6 to near the wellbore bottom 8. The liner 14 includes an upper

part in the form of liner tube 20, and a lower part in the form of a tubular sandscreen 22 which is adapted to substantially prevent inflow of sand into the liner 14 during production of hydrocarbon oil from the formation zone 4. The liner tube 20 and the sandscreen 22 are interconnected by a pin-box type connector 24. An upper portion 18 of the liner tube 20 which extends into the casing 6 has been radially expanded against the inner surface of the casing 6 so as to form a tight interference fit with the casing 6.

The sandscreen 22 includes a fluid conduit in the form of base pipe 26 provided with through-holes 28, a filter layer 30 around the base pipe 26, and a swelleable sleeve 32 around the filter layer 30.

In Figure 1 the right-half portion of the sandscreen 22 is shown in longitudinal section and the left-hand portion is shown in side view, whereby parts of the filter layer 30 and sleeve 32 of the left-hand portion are removed for the sake of clarity.

The sleeve 32 is made of a swelleable polymer in elastomeric configuration, which polymer swells when it comes into contact with water. A suitable water swelleable polymer is starch -polyacrylate acid graft copolymer. The material of the sleeve 32 does not significantly swell when it comes into contact with hydrocarbon oil. Furthermore, the sleeve is provided with a plurality of fluid passages in the form of through-openings 34. The size of the through-openings is such that these become closed when the polymer material of the sleeve 32 swells upon contact with water.

During normal operation the casing 6 is lowered and cemented in the wellbore 1, whereafter the liner the liner 14 is lowered through the casing 6. Subsequently the

liner 14 is radially expanded by pumping, pushing or pulling an expander through the liner 14 whereby both the liner tube 20 and the sandscreen 22 are expanded.

5 The upper portion 18 of the liner tube 20 becomes firmly fixed to the casing 6 as a result of the expansion process.

Oil is then produced from formation zone 4, via the sandscreen 22 to the interior of liner 14, and from there to surface via one or more production tubings
10 (not shown). During the lifetime of the well the level of the oil/water contact at the interface of zones 4 and 5 may rise due to depletion of the oil reservoir. As the oil/water contact reaches the lower end of the sandscreen 22, the polymer material of a lower end part
15 of the sleeve 32 which has come into contact with formation water, swells as a result of the contact with the water. The through-openings 34 in the lower end part of the sleeve 32 are thereby effectively closed. In this manner it is achieved that formation water is prevented
20 from flowing into the lower end part of the sandscreen 22, while oil can still flow into the remaining upper part of the sandscreen 22. The amount of through-openings 34 which become closed will gradually increase as the water level rises, until all through-openings 34 are
25 closed when the water level has reached the upper end of the sandscreen 22.

The swelleable sleeve 32 therefore effectively prevents production of significant amounts of formation water during the lifetime of the well.

30 It will be understood that the scope of the present invention is not limited to application of the sleeve of swelleable material described above, and that variations whereby a swelleable material induces increased inflow

resistance of an undesired fluid when the material swells upon contact with the undesired fluid are included in the scope of the invention.

5 Instead of applying the swelleable sleeve around the filter layer, the sleeve can be applied between the filter layer and the base pipe. Furthermore, the sleeve can be provided with an outer protective shroud.

10 Instead of expanding the upper portion of the liner against the casing to create an interference fit, a conventional liner hanger can be used.

 Instead of applying the sleeve directly to the filter layer, the sleeve can be applied on a carrier weave of an inert material, such as steel, glass-or carbon-fibre or a non-swelling polymer.

C L A I M S

1. A wellbore device comprising a fluid passage for transferring fluid between an earth formation and a surface facility, and a body transferable from a first mode to a second mode upon contact of the body with a selected fluid, said body being arranged so as to substantially close the fluid passage upon transfer of the body from the first mode to the second mode due to contact of the body with the selected fluid.

2. The wellbore device of claim 1, wherein the wellbore device is adapted to be arranged in a wellbore formed in the earth formation.

3. The wellbore device of claim 1 or 2, wherein said body has a larger volume in the second mode than in the first mode.

4. The wellbore device of any one of claims 1-3, wherein said body comprises a body of swelleable material which swells upon contact of the body with the selected fluid, said body of swelleable material being arranged so as to substantially close the fluid passage upon swelling of said body due to contact of the body with the selected fluid.

5. The wellbore device of claim 4, wherein the fluid passage is formed in the body of swelleable material.

6. The wellbore device of claim 5, comprising a first said fluid passage formed in a first part of said body and a second said fluid passage formed in a second part of said body, wherein the first fluid passage is closed due to contact of the first body part with the selected fluid, and wherein the second fluid passage is open.

7. The wellbore device of claim 6, wherein the first body part comprises a plurality of said first fluid passages, and the second body part comprises a plurality of said second fluid passages.

5 8. The wellbore device of any one of claims 4-7, wherein said body of swelleable material is formed as a tube, and wherein the, or each, fluid passage passes through the wall of the tube.

10 9. The wellbore device of claim 8, further including a perforated tubular conduit, and wherein the body of swelleable material is formed as a sleeve extending around the perforated tubular conduit.

15 10. The wellbore device of claim 9, wherein the perforated tubular conduit is provided with a filter layer for preventing flow of solid particles from the earth formation to the surface facility so as to form a sandscreen.

20 11. The wellbore device of claim 10, wherein the filter layer is arranged between the perforated tubular conduit and the sleeve of swelleable material.

12. The wellbore device of any one of claims 9-11, wherein the sleeve is one of the group of a permeable sleeve, a perforated sleeve, and a sleeve having an open weave structure.

25 13. The wellbore device of any one of claims 9-12, wherein the perforated tubular conduit is radially expandable.

30 14. The wellbore device of claim 13, wherein the wellbore device is arranged in the wellbore and wherein the sandscreen has been radially expanded so that the sleeve is substantially in contact with the wellbore wall.

15. The wellbore device of any one of claims 1-14, wherein the selected fluid is earth formation water.

16. The wellbore device of any one of claims 1-15,
wherein said body comprises a water swelleable material
selected from the group of starch -polyacrylate acid
graft copolymer, polyvinyl alcohol cyclic acid anhydride
5 graft copolymer, isobutylene maleic anhydride, acrylic
acid type polymers, vinylacetate-acrylate copolymer,
polyethylene oxide polymers, carboxymethyl cellulose type
polymers, starch-polyacrylonitrile graft copolymers and
the like, highly swelling clay minerals, Sodium
10 Bentonite, and Sodium Bentonite having as main ingredient
montmorillonite.

17. The wellbore device substantially as described
hereinbefore with reference to the drawings.

TS 6387 EPC

A B S T R A C T

A wellbore device is provided which comprises a fluid passage for transferring fluid between an earth formation and a surface facility, and a body transferable from a first mode to a second mode upon contact of the body with a selected fluid. Said body is arranged so as to substantially close the fluid passage upon transfer of the body from the first mode to the second mode due to contact of the body with the selected fluid.

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TS 63.87

FIG. 1

